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Tests and Analyses on the Pedestrian Suspended-Slab Bridge

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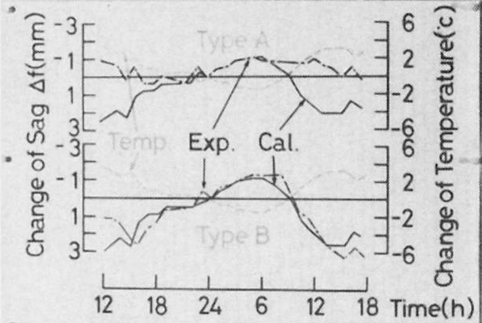
A suspended-slab bridge (Spannband-Brücke) is essentially the same structural system as the suspended-roof in buildings. This type bridge is made by spanning of tendons which are lined with reinforced concrete to provide the rigidity as slab. Its advantage is not only applicable to long span, but also unnecessary to use the elements such as main towers, hangers and stiffened members in a conventional suspension bridge, and almost free from the maintenance works. However, these bridges are very few, because we have only an insufficient knowledge on their characteristics of deflection or vibration and the effects of cracking about such a structure.

For these reasons, authors have conducted following experiments; firstly, to construct two model bridges of this type for pedestrians with a span of 10m and a width of 0.7m which were designed by using the span/sag ratio, 100 (Type A) and 50 (Type B), respectively; secondly, to investigate the behaviour of these bridges due to temperature variations and pedestrian-actions; thirdly, to measure the cracks relating to the sand-loading test; and finally, to execute the shaking test.

The main points obtained from the experimental results are summarized as follows; 1) cracks appeared in the slab near the bridge seat due to the mere change of temperature; 2) when static loading up to about 1.0t/m, which is 4.1 times as large as the design load, were applied, the number of cracks appeared in the slab was 77 in Type A per span length 10m (mean crack spacing ℓ_{mean}=13cm; maximum crack width w_{max}=0.8mm appeared near the bridge seat); and 71 in Type B (ℓ_{mean}=14cm, w_{max}=0.7mm), respectively, but all these cracks closed after removing the load; 3) although the vibration mode was close to bending vibration in the case of no crack or few cracks, the mode approached to longitudinal vibration of tendons as the number of cracks were increasing, and the resonance frequency had a tendency to decrease; 4) smaller span/sag ratio is not only favorable for all mechanical properties such as deflection, vibration, cracking et al., but also economical.

TESTS & ANALYSES ON PEDESTRIAN SUSPENDED SLAB BRIDGE

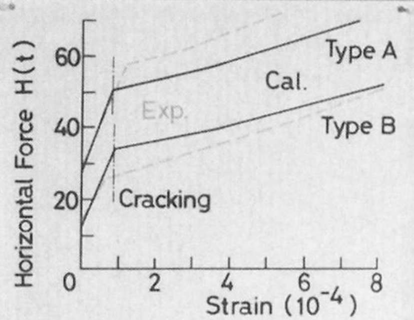


Change of Sag due to Change of Temperature

Calculated results agree well with the experimental results.

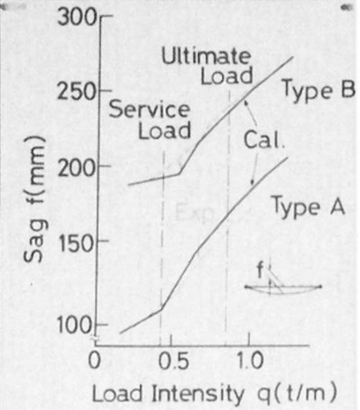
Model Suspended Slab Bridges

Left: Type A, Right: Type B
Span 10m, 10m
Sag 0.10m, 0.20m



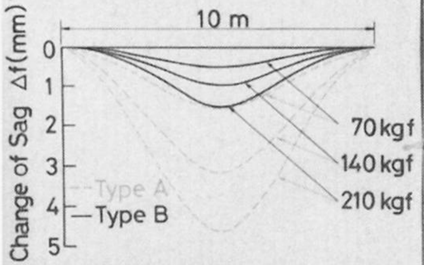
Horizontal Force-Strain Curves

The elongation rigidity deteriorates suddenly when crack appears.



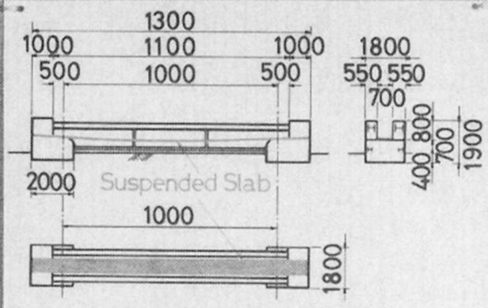
Sag-Load Curves

The sag increases suddenly when crack appears.



Influence Lines of the Change of Sag

The principle of superposition is applicable. The change of sag of Type A is about three times as large as the change of sag of Type B.



General View of Model Bridge

Various experiments and measurements to make clear the mechanical characteristics of pedestrian suspended-slab bridge have been carried out for a long period. As is possible to shorten the term of works, this type is suitable for the pedestrian bridge (span 50-100m) to cross not only the valley but also the street.

Resonance Frequency and Damping Constant

Crack Condition	Type A Freq. (Hz)	Type A Dam.Con. (%)	Type B Freq. (Hz)	Type B Dam.Con. (%)
No	5.10	1.4	7.58	0.9
Initial	3.43	—	7.14	—
Ultimate	3.10	1.6	3.76	1.6

As cracks appear, the resonance frequency decreases.

Proposed Hayakawa Bridge
(Span 113m, Width 2.85m, Sag 2.65m)